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INVESTIGATIVE REPORT

Implementation of Recommendations for Hand Eczema Through a Multifaceted Strategy. A Process Evaluation Among Health Care Workers

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Process data give important insights into how an intervention is implemented. The aim of the present study is to conduct a process evaluation, alongside a randomised controlled trial, on the implementation of recommendations for the prevention of hand eczema. The intervention was carried out in healthcare workers' departments and consisted of working groups and role models. The role models were selected based on their representativeness, their influence on colleagues, and their motivation. The focus of the working group was to implement recommendations for hand eczema at the department by choosing solutions to overcome barriers for implementation. Out of the 104 solutions, 87 were realised. Solutions regarding moisturisers and use of cotton under gloves, were used by 90.9% and 30.8% of the employees, respectively. Of all participants, 58.2% actively engaged with the role models. This process evaluation showed that the intervention was executed according to protocol and that the solutions were implemented well. However, the role model component in the intervention should be improved. Key words: process evaluation; implementation; hand eczema; health care workers.

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Many researchers now perform a process evaluation alongside their randomised controlled trials (1). Process data are important because they give researchers important insights. First, it helps with the interpretation of, as well as ultimately explaining, the results of effect evaluation (1, 2). This becomes increasingly important when the results are different than expected (2). A process evaluation can also be the floodlight for factors within the intervention that are crucial for success and for aspects that can lead to failure (3). This enables researchers to learn what they can improve in future interventions (2), and their implementation.

For studies on the prevention of hand eczema, process evaluations are scarce. There is only one known randomised controlled trial which included this type of evaluation (4) and there are just 2 studies that discuss implementation of interventions in this research field (5, 6). As not every intervention targeted at hand eczema was found to be effective in reducing hand eczema or preventing the condition (7, 8), process data are necessary to explore why the intervention did not work as expected. However, a process evaluation can also give valuable information when there are positive results. More process evaluations are thus needed in this field of research.

In the present study we will describe the process evaluation for the Hands4U study. The Hands4U study uses a multifaceted implementation strategy to employ evidence-based recommendations for the prevention of hand eczema in several health care centres. These recommendations were derived from the guideline of the Netherlands Society for Occupational Medicine (NVAB) (9) and are in line with the review of Agner & Held on skin protection programs (10).

Performing a process evaluation for the Hands4U study is important for 2 reasons: first, the implementation strategy of Hands4U contains multiple components, making the strategy difficult to implement (11). Therefore, we need to study if the implementation of the strategy was performed as planned, since the extent of the implementation can influence the outcomes of the effect evaluation (1, 12). Secondly, it is important to study whether the implementation strategy is a feasible strategy in a health care setting, for broad implementation, and whether participants are content with the strategy chosen.

The goal of the present study is 1) to perform a process evaluation for the multifaceted implementation strategy, in order to evaluate whether the strategy was conducted as planned, and 2) to assess the feasibility of the multifaceted implementation strategy and the implementation of the NVAB recommendations in a health care setting.

METHODS

This process evaluation was performed alongside a randomised controlled trial (RCT), the Hands4U study. Hands4U is a study

on the prevention of hand eczema among health care workers in the Netherlands. A detailed description of the methods of the RCT, randomisation procedures, and intervention has been described elsewhere (13).

Study population

The study population consisted of health care workers who were allocated to the intervention group of the Hands4U study consisting of the multifaceted implementation strategy. Randomisation to the control or intervention group was performed at the level of departments. The departments started with the study between April 2011 and May 2012. The intervention group consisted of 876 participants spread over 23 departments. We did not invite all participants in the intervention group to reduce the burden of completing lengthy questionnaires for the participants. Therefore, we invited as many participants as we considered necessary to obtain insight into the process of the intervention. We invited 558 participants (63.7%), spread over 16 departments, to participate in the process evaluation. We made this selection based on the moment the departments started the study (between April 2011 and January 2012) and the location of these departments (Amsterdam, Nijmegen, and Groningen).

Multifaceted implementation strategy

The multifaceted implementation strategy consisted of several components, including a leaflet containing the recommendations for the prevention of hand eczema. Below, the components of the multifaceted implementation strategy are briefly described.

The participatory working groups and role models. The central component of the multifaceted implementation strategy was the participatory working groups. At the first meeting the working group was briefed about the goal of the meetings: to identify problems with adherence to recommendations, to find solutions to these problems, and to implement the solutions at department level. These recommendations – derived from the NVAB-guideline (9) – consisted of 5 main recommendations, as displayed in Table I. Before the second meeting, one month later, the working group received a report on the hand eczema risk at their department. During the second meeting this report was discussed and problems with adherence were addressed. The second meeting resulted in an implementation plan for the department containing solutions for the problems with adherence to the recommendations. The purpose of the third meeting was to evaluate the implementation plan formulated in the second meeting.

In an additional meeting directed by a trained occupational nurse, working group members were trained to become role models for their colleagues. The role models were trained to encourage their colleagues to participate in the use of the recommendations, and demonstrate how to use the recommendations.

At least one working group was formed at each department. Members of the working group were selected by the department manager based on their representativeness, their influence on colleagues, and their motivation. Each working group had to contain at least one manager.

The education program. The goal of the education program was to inform all workers about the risk of hand eczema and the prevention of hand eczema, to make them aware of their own

risk behaviour, and to train them in the actual use of individual preventive measures, tailored to NVAB guideline (9).

The program was a 20-min session and was planned during a regular meeting of the workers at their respective department. The program was planned and performed by the trained occupational nurse. If necessary, more sessions were held to increase the reach of education.

All workers participating in the session received a bag containing products related to the prevention of hand eczema, such as moisturisers and cotton under gloves. Afterwards, the role models placed posters with key messages (reminders) at sinks or other relevant places at the department.

Data collection

Workers at participating departments received 2 questionnaires: one at 6 months after baseline and one 9 months after baseline.

There were 3 separate questionnaires for the working group members. After the role model training and after the last meeting of the working group, we asked the working group members to fill out a questionnaire. Further, a questionnaire was sent to the working group members 6 months after baseline.

Definitions and outcome measures

The process evaluation of the Hands4U study was based on the components defined by Linnan & Steckler (1). They defined 7 components for the evaluation of a study. In the present study, we assessed 4 components: reach, dose delivered, dose received, and fidelity. In addition, satisfaction was added to the framework. The components were analysed at 3 levels: occupational nurse level, who performed the intervention; working group/role model level; and the employee level. Table SI¹ describes, per level, how we defined the components, how we measured the components, and when we measured the components.

Dose delivered

Occupational nurse level. The dose delivered was defined as the proportion of departments, where at least one education session was given, and the proportion of working group meetings given by the occupational nurse at the participating departments. This could be derived from the log book and the minutes from the working group meetings.

Working group level. The dose delivered at the working group level was defined as the proportion of solutions – defined during working group meeting 2 – which was implemented at the department (yes/no). We determined whether a solution was implemented by means of a questionnaire sent to the working group members 6 months after baseline. We considered a solution delivered when one working group member reported that the solution was implemented at the department. We chose this cut-off point because in many cases only one working group member was responsible for the implementation of a specific solution. Because of this, in some cases, just one working group member knew whether a solution was implemented. In addition, the solutions were divided into categories. We divided the solutions in the recommendations for the prevention of hand eczema, creating 7 categories: moisturiser, hand disinfectant/hand hygiene, gloves, cotton under gloves, jewellery, reducing wet work, and recommendations in general².

The working group members were also asked to act as role models. The dose delivered for that component was determined by whether the working group members performed any tasks

Table I. Main recommendations for the prevention of hand eczema

1. Use disinfectant instead of water and soap to disinfect the hands
2. Wear gloves when performing wet work
3. Wear cotton under gloves when you wear gloves for longer than 10 min
4. Use a moisturiser on daily basis to nurse the skin
5. Do not wear jewellery at work

¹<http://www.medicaljournals.se/acta/content/?doi=10.2340/00015555-1830>

as a role model (yes/no). This was assessed by means of a questionnaire 6 months after baseline.

Fidelity

We defined fidelity as the extent to which the occupational nurse was compliant to the intervention protocol for the participatory working groups. During the working groups, the group members followed 7 steps: 1) introduction and workplace observation; 2) selection of problems with adherence; 3) selection of solutions; 4) design of the implementation plan; 5) implementing the solutions; 6) evaluation of implementation plan; 7) maintenance of the solutions. The occupational nurse was responsible for 5 of these 7 steps (step 1, 2, 3, 4 and 6). For each step, we calculated the extent to which the step was performed as planned by means of a percentage. We added up the percentages per step for each working group and divided this number by the number of working groups. Hereby, we created a mean fidelity score per step. Also, we calculated the total fidelity score per working group by adding up the percentages per step and dividing them by the number of steps. These overall scores were added up and divided by the number of working groups, creating a mean overall fidelity score for the intervention protocol.

Reach

Working group level. At this level, reach was defined as the proportion of working groups formed, including the number of working group members. As working group members were all invited for role model training, the reach of the working group was equal to the reach of the role model training.

Employee level. Reach at the employee level was defined as the percentage of the total study population who reported to have received the leaflet (yes/no); who reported to have seen the reminders (yes/no); who noticed the role models (yes/no); and who noticed the implemented solutions within their department (yes/no). We measured this by means of a questionnaire 6 months after baseline. The questions on the solutions were incorporated into the questionnaire 9 months after baseline.

In addition, solutions were categorised based on the recommendations for the prevention of hand eczema as described under the heading 'dose delivered'. For each solution we calculated the percentage of employees who noticed that specific solution. These percentages were added up per category and divided by the number of solutions in that category, thereby creating an overall reach per category. We only added up the percentages of the solutions that the working group members reported as delivered.

Dose received

Working group level. We defined 'dose received' as the proportion of working group members who attended all 3 working group meetings and the proportion of working group members who attended the role model training. We assessed this by means of a questionnaire 6 months after baseline.

Employee level. The dose received was defined as: the percentage of workers who used the implemented solutions; who read

the leaflet; who actively engaged with the role models; and who followed the education session. We measured this by means of a questionnaire 6 months after baseline. The questions on the solutions were assessed 9 months after baseline. To calculate the dose received, we calculated the number of employees who used the component as percentage of the reach at employee level. This gave us insight into whether the employees who were reached also received the components of the intervention.

In addition, the solutions were categorised based on the recommendations for the prevention of hand eczema as described under the heading 'dose delivered'. For each solution we calculated the percentage of employees who used the specific solution. These percentages were added up per category and divided by the number of solutions in that category, thereby creating an overall dose received percentage per category. We only added up the percentages of the solutions of which the working group members reported that the solution was delivered.

Satisfaction (see Appendix S1¹)

RESULTS

Response

Working group level. Of the 70 working group members within 16 departments, 46 (65.8%) filled out the role model questionnaire, 42 (60.0%) filled out the questionnaire after the last meeting, and 57 (81%) filled out the 6 months questionnaire.

Employee level. Of the 558 participants, 310 (55.5%) responded to the process questionnaire 6 months after baseline and 265 (47.5%) responded to the questionnaire 9 months after baseline.

Population characteristics

Table II describes the baseline characteristics of the multifaceted implementation strategy participants who participated in the process evaluation and the total population of health care workers who participated in this strategy. As Table II shows, the population for the present study slightly differs from the total population for gender, education, and having symptoms related to hand eczema at baseline.

Table II. Baseline characteristics

Variable	Population process evaluation (n=310)	Total population multifaceted implementation strategy (n=876)
Female, n (%)	232 (75.1)	683 (78.4)
Education, n (%)		
Low/middle ^a	119 (38.5)	371 (42.6)
High ^b	190 (61.5)	499 (57.4)
Patient-related task, n (%)	219 (71.1)	604 (69.4)
Hand eczema at baseline, n (%)	25 (8.1)	64 (7.3)
Symptoms related to hand eczema at baseline, n (%)	113 (36.8)	361 (41.6)
Age, years, mean (SD)	41.0 (11.6)	40.7 (11.5)
Working hours per week, mean (SD)	30.4 (8.4)	29.8 (8.1)

^aprimary school; middle education, basic vocational education, secondary vocational education, high-school degree. ^bhigher vocational education or university degree.

²We also used a second method, which was to categorise the solutions by the nature of the solution: products; education and information; counselling and modelling; and protocols. Products refer to solutions like the purchase of a new product, the replacement of a product, or appointing a fixed place for an existing product. Solutions on education and information were solutions like a clinical lesson or a newsletter. Counselling and modelling were solutions where, for instance, employees were encouraged to change their behaviour. The final category, protocols, refers to a change in protocol within a department.

Characteristics of the solutions

In total, the working group members of the 16 departments prioritised 104 solutions, a mean of 6 solutions per department (range 3–12). Table III shows the distribution of the solutions over the categories. The largest group of solutions for this classification was moisturisers (34.6%), followed by solutions on hand disinfectant (24.0%). Secondly, the solutions were sorted according to the nature of the solution. Most of the solutions were on education and information (43.3%) and products (42.3%).

Dose delivered

Occupational nurse level. In total, the nurses held 64 meetings (including the role model training) out of the 68 meetings that were planned (94.1%). For the role model training, the occupational nurses delivered a total of 16 role model training sessions for the 17 working groups (94.1%). One working group refused to follow the role model training, because they considered it unnecessary. The same was the case for the first working group meeting: 16 meetings were held among the 17 working groups (94.1%). The second working group meeting was delivered 17 times (100%) and the third working group meeting was delivered 15 times (88.2%). The third meeting was cancelled for 2 of the departments, because the managers of the 2 departments considered the third meeting to be excessive and too time consuming. The occupational nurses delivered at least one education session for every department (100%).

Working group level. Out of the 104 solutions, 87 were implemented according to the working group members (83.7%). Table III shows that solutions on reducing wet work and jewellery were all delivered. The solutions on cotton under gloves were implemented least (62.5%). In summary, all the solutions on counselling and modelling, and on protocols were delivered. The solutions on education and information were delivered less often (80.0%).

Of the role models, 92.7% reported that they performed tasks (i.e. advised colleagues, sent e-mails on the topic) related to being a role model.

Table III. Solutions per category and dose delivered for the solutions at working group level

	Amount of solutions, <i>n</i> = 104 <i>n</i> (%)	Dose delivered <i>n</i> = 104 <i>n</i> (%)
Recommendations		
Moisturiser	36 (34.6)	29 (80.6)
Hand disinfectant/ hand hygiene	25 (24.0)	23 (92.0)
Recommendations in general	15 (14.4)	12 (80.0)
Gloves	14 (13.5)	12 (85.7)
Cotton under gloves	8 (7.7)	5 (62.5)
Reducing wet work	4 (3.8)	4 (100)
Jewellery	2 (1.9)	2 (100)
Nature of solution		
Education and information	45 (43.3)	36 (80.0)
Products	44 (42.3)	36 (81.8)
Counselling and modelling	13 (12.5)	13 (100)
Protocols	2 (1.9)	2 (100)

Fidelity

The fidelity of the occupational nurses to the total intervention protocol for the participatory working groups was 84.5%. We also evaluated the fidelity for each individual step: step 1 (81.4%), step 2 (92.2%), step 3 (86.3%), step 4 (83.3%), and step 6 (79.4%).

Reach, dose received and satisfaction at the working group level

Reach. Within the 16 participating departments, 17 working groups were formed. Every department had at least one working group. One department had 2 working groups as that department has 2 divisions that perform different tasks. Therefore, they preferred 2 separate working groups. In total, 70 health care workers participated in the working groups, a mean of 4 members per working group. In 4 of the working groups, there was no manager present at the meetings (23.5%).

Dose received. Of the working group members 52.6% followed all 3 working group meetings and 78.8% reported that they followed the role model training.

Satisfaction (see Appendix S1¹)

Reach, dose received and satisfaction at the employee level

General overview. Of the participants, 97.4% (*n* = 302) noticed that their department participated in the Hands4U study. Table SII¹ shows the overall reach, dose received, and satisfaction at employee level. The reminders for the recommendations (posters) were seen by 77.6% of the study population. Satisfaction with the components of the multifaceted implementation strategy was above the midpoint of a 5 point scale (midpoint: 2.5) or a 10 point scale (midpoint: 5.0).

Reach and dose received for the solutions. Table SIII¹ shows the mean reach and dose received of the solutions implemented at the department. The solutions are categorised according to the recommendations of the NVAB guideline. On average, the reach of the solutions on reducing wet work was the highest (75.9%), followed by the solutions regarding moisturiser (reach: 64.7%). Dose received was the highest for solutions regarding jewellery (100.0%), followed by solutions regarding hand disinfectant or hand hygiene (90.5%). The solutions of cotton under gloves was the only category that had both a reach under 50% and a dose received under 50% (reach: 43.1%, dose received: 30.8%). The reach for solutions regarding jewellery and gloves was lower than 50%, but the dose received was above 90%.

DISCUSSION

In general, the majority of the components within our multifaceted implementation strategy had – to our opi-

nion – an adequate dose delivered, fidelity, reach, dose received, and satisfaction. As there is no consensus for a cut-off point for these components, we consider a cut-off point of 60% as adequate, considering the complex design of our study and the large number of participants. However, there are some aspects of the strategy that can be improved. We will discuss these points per component.

Interpretation of results

The working group sessions. The occupational nurse delivered almost all the working group meetings at the participating departments with a high fidelity to the intervention protocol. Working groups were formed at every participating department. Almost half of the working group members missed at least one meeting. These attendance rates are quite low compared to other studies using participatory working groups (14, 15). However, due to the work shifts of the working group members it was not always possible to plan meetings at times convenient for all members. We tried to keep all working group members up-to-date by sending the minutes of the meetings.

In almost 25% of the working groups no managers participated in the working group sessions. For 2 of these working groups, 40–70% of the solutions were not delivered at the department. The other 2 working groups delivered all the solutions. According to the literature, support of a supervisor is considered to be important for the implementation process (16). However, our study cannot confirm or reject this, because only few working groups did not include a supervisor. In addition, the implementation rate of the working groups without a supervisor ranged from low to high.

The prioritised solutions

Choosing and delivering solutions. The working group members implemented more than 80% of the solutions that they came up with during the working group meetings. A study on prevention of lower back and neck pain with a comparable design found that only 34% of the prioritised solutions were delivered at the departments (14). Although there is no cut-off point for a high dose delivered, Durlak and DuPre suggest in their review that only a few studies have attained implementation levels above 80% (12). Therefore, we consider the dose delivered in our study as high.

From the 5 main recommendations, the majority of the solutions from the working groups focused on 2: hand disinfectant/hand hygiene and moisturisers. There might be multiple reasons why these solutions were chosen most often. Firstly, solutions on hand disinfectant/hand hygiene were not only beneficial for the prevention of hand eczema, they were also in line with the hand hygiene protocols at the department. When a working group chose for a solution on hand hygiene, the benefit for the department was 2-fold. This might have increased the attractiveness of these solutions. Secondly, for moisturisers there was a lot to gain, because most workers (81%) did not use a moisturiser on a daily basis at baseline (unpublished data). Before the second working

group meeting, all members of the working group received a report on the use of moisturisers at the department. This report could have been the trigger for the working group to choose for solutions on moisturisers. On the contrary, cotton under gloves were used by only 2% of the population at baseline (unpublished data), but was prioritised only 8 times by the working groups. The reason why this recommendation was prioritised so few times could be due to the participatory approach itself. A well-known problem with this approach is that it mainly tackles the easy changes, the so-called 'low-hanging fruits' (17). During the working group sessions, the occupational nurse stimulated the working group members to choose solutions that were relatively easy to implement. This was accomplished by scoring the solutions on items like compatibility, costs, and complexity. The solutions that scored best on these items were most likely to be chosen by the working group members. Hand hygiene and the use of moisturisers were solutions the working group members were already familiar with, though the use of cotton under gloves was very new for almost every department. This limited the chance that a working group would select solutions on cotton under gloves. In conclusion, the participatory method on the one hand ensures that the working group choose the most feasible solutions; on the other hand this means that solutions that require more effort might never be selected by the working group due to the prioritisation procedure³.

Reach and dose received at employee level. Almost every employee noticed and used at least one solution for their department. The reach and dose received were highest for solutions on hand hygiene, moisturisers, and performing (less) wet work. The relatively high dose received for hand hygiene might be explained by the dual benefit of the solutions on hand hygiene, namely the prevention of hand eczema and compliance to hand hygiene protocols. Further, solutions on the reduction of wet work were received well, but due to the small amount of solutions it is questionable whether this finding can be generalised. Cotton under gloves had the lowest reach and dose received. Even if a working group prioritised this recommendation, the implementation process stagnated at the employee level. Probably, the implementation of this recommendation is hindered by barriers that were not taken into account by the working group; or the working group came across barriers during the implementation process that were previously unknownst to them.

³Apart from the categorisation of the recommendations, we also categorised the solutions according to their nature. The solutions prioritised by the working group members mainly consisted of 2 broad categories: solutions on products and solutions on education and information. Improving products has been shown to have an effect on implementation according to the study of Van Achterberg et al. (18). On the contrary, educational strategies – the other large category – as single strategies, showed to be ineffective in enhancing compliance in nurses (18). However, since the solutions were implemented within the context of our multifaceted strategy they should not be considered as single strategy. In addition, it is important that an implementation strategy is in line with the barriers for implementation (19). When a lack of knowledge is considered to be one of the barriers for implementation, an education session might be a suitable strategy nonetheless.

Role models

Role model training was delivered to the majority of the departments. Almost every working group member stated that they performed tasks related to being a role model. These tasks ranged from sending an e-mail to advising a colleague.

Of the employees, less than 40% of the total population actively engaged with the role models. This makes it difficult for the role models to influence their social environment, which is an important barrier for implementation (16). There could be several reasons why the role models had less of an impact than expected, and we have some ideas of how their role could be improved. The role models in our study were selected by the manager of their department; however, according to the literature, being a role model is not a formal position, but it is a position that is earned by an individual over the years (20). For the selection of the role models in our study, we asked the managers to choose individuals who had influence on colleagues. However, we do not know whether they truly were role models by nature. Therefore, it would be advisable to make more of an effort in selecting individuals for role model training, ideally those who already fulfil this role at the department. A disadvantage of this approach is that it is difficult to identify these natural role models within the departments (21). In addition, training of an hour and a half – the duration of the role model training – might not have been sufficient to prepare the working group members for their function as role models. Other factors that could have played a part are that the role models may not have had enough time to perform their role, and working in different shifts could limit the contact between role models and their colleagues.

Education, leaflet and reminders

The reminders and the leaflet were implemented well. The educational sessions were visited by only half of the study population. It would have been beneficial for the implementation of the recommendations if more employees had followed the education session, as a lack of knowledge and awareness can be barriers for implementation (3, 16). A major obstacle for the education sessions could have been the time schedules of the workers. In a hospital setting, not every nurse can attend an education session, as there always have to be nurses available at the department. We tried to solve this by encouraging the occupational nurses to plan more than one education session at each department. However, planning more than one session was not obligatory. We asked the occupational nurses to decide whether this was necessary. To improve attendance levels for education sessions, we therefore advice planning more than one session beforehand, and not to leave this decision to the occupational nurses. Most ideally, these meetings should be planned at different times and different days, so that there is a convenient point of time for every worker.

Strengths and weaknesses

One of the main strengths of this study is the way we investigated the process of our strategy, and that we used a model to structure our findings. The model of Steckler & Linnan (1) enabled us to describe the implementation of the multifaceted implementation strategy thoroughly. Further, we divided the solutions into the recommendations our strategy was aimed at (cotton under gloves, moisturiser, jewellery, wet work, gloves, disinfectant). This made it possible to identify recommendations that were relatively easy to implement, versus recommendations that were more difficult to implement. Having this information can give researchers important insights into whether recommendations are feasible (or not) for a department in a health care setting. Another strength was that the participants involved in this process evaluation could be considered representative based on the fact that there were little differences between the total group of participants offered the multifaceted implementation strategy and the subgroup in the present study.

A limitation of our study is that the response to the employee questionnaires was quite low, though baseline characteristics of the group that did respond were similar to the total intervention group. However, we cannot rule out that other factors we did not measure could have been different between the 2 groups, which may have limited the representativeness. In addition, the selection of participants for the process evaluation could have introduced selection bias, as we did not invite all participants. The departments that started the study after January 2012 were not included. These departments might have been less enthusiastic, as they started the study last. However, we have no information about participation rates for these departments, as they were not approached to participate in the process evaluation. Further, it could be questioned whether our way of calculating the dose delivered was the best way. If at least one working group member stated that the solution was delivered, we considered the solution as delivered. However, the present cut-off point was considered as the most reliable considering our strategy. Another limitation was the use of different scales for the assessment of satisfaction, because the questions had a different origin. Using either a 5-point scale or a 10-point scale would have made the results on satisfaction more comparable. A final limitation is that we did not monitor whether a person from the infection control department was present at the meetings of the working group, as described in our study protocol. The working groups decided for themselves whether they wanted to invite this person to take into account the rules for hand hygiene. As the recommendations used in our study are in line with these rules, we found it unnecessary to make the presence of a person from the infection control department obligatory.

Implications for practice and research

Considering the outcomes of the process evaluation, our multifaceted implementation strategy seems feasible in

terms of applying in daily practice. However, some points need to be considered in future research and in practice.

Firstly, as the implementation of cotton under gloves partly failed, it would be advisable to study barriers for implementation. Our implementation strategy mainly focused on solutions that are relatively easy to implement as they have a higher implementation chance. Solutions with multiple obstacles, such as cotton under gloves, will as a consequence be implemented less. Therefore, for cotton under gloves it is necessary to find another implementation strategy suitable for this recommendation. Secondly, although the role models performed tasks that were noticed, it would be important to make them more influential. The presence of a leader (role model) and social support are all factors that can enhance implementation (16). As the role models in our study represent these factors they can play an important role in the implementation process. More research is thus needed to investigate the limited implementation of the role models in our study. Thirdly, the amount of education sessions could be enhanced to enlarge the reach of these sessions. Fourthly, qualitative research is recommended to study the underlying reasons why implementation of some recommendations failed and the implementation of others were successful. Another point of consideration is the transferability of the results to other studies and settings. Some of our findings may be highly site specific. For instance, the limited implementation of cotton under gloves might be due to problems specific for the sites where the study was performed. However, many other findings can be translated to implications for other research. For instance, the finding that working groups mainly seem to select the 'low hanging fruits'. Another generic implication is that hand hygiene rules at hospitals are in accordance with hand eczema prevention and might therefore be more easy to implement.

Conclusions

The process evaluation of the Hands4U study showed that the multifaceted implementation strategy is executed according to protocol. The majority of the components of our multifaceted implementation strategy had an adequate dose delivered, fidelity, reach, dose received, and satisfaction. The strategy was also feasible in a health care setting. However, the role model component in our strategy could especially be improved and needs further study.

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